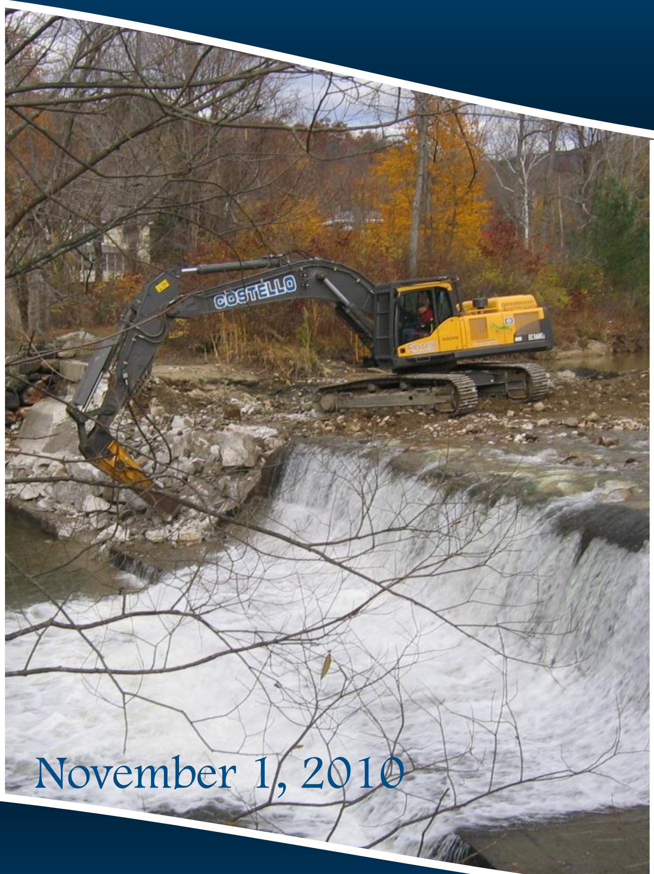
Jun 5th, 3:45 PM - 4:05 PM

Session C3 - Fish Passage Restoration at the Briggsville Dam: Using Sediment Transport Analysis for Natural Channel Design

Jessica Louisos
Milone & MacBroom, Inc.

FISH PASSAGE RESTORATION AT THE BRIGGSVILLE DAM: USING SEDIMENT TRANSPORT ANALYSIS FOR NATURAL CHANNEL DESIGN

August 31, 2009



November 1, 2010


April 28, 2011

Presented to:
National Conference on Engineering and Ecohydrology for Fish Passage
University of Massachusetts Amherst

June 5, 2012

Presented by:
Jessica C. Louisos
Roy Schiff, Jim MacBroom
Milone & MacBroom, Inc.

PROJECT PARTNERS

Project partners include Cascade School Supplies, the USDA Natural Resources Conservation Service, American Rivers, the Town of Clarksburg, the Massachusetts Division of Ecological Restoration, the U.S. Fish and Wildlife Service, the Eastern Brook Trout Joint Venture, the Wildlife Conservation Society, Hoosuc Chapter of Trout Unlimited, the Corporate Wetlands Restoration Partnership, Proctor & Gamble, nationalgrid, the Hoosic River Watershed Association, MassWildlife, Sweet Water Trust and the Massachusetts College of Liberal Arts, Milone & MacBroom, Inc., Fuss & O'Neill, Inc.

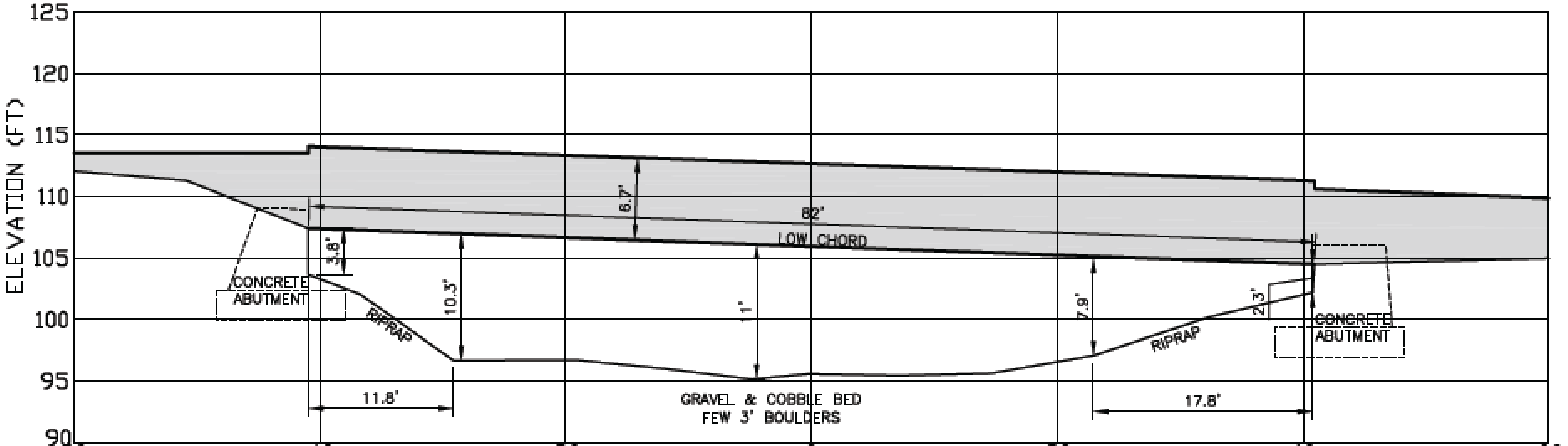
PROJECT GOALS

- Remove Briggsville Dam
  - 15 feet high
  - 145 feet long
  - Concrete structure
- Reconnect 30 miles of headwater streams along the North Branch of the Hoosic River
- Improve Fish Passage and Local Habitat for:
  - Eastern brook trout
  - Longnose sucker
  - Slimy sculpin
- Reduce flood risks associated with possible dam failure

PROJECT CONSTRAINTS

- Cross Road Bridge – 750 feet upstream
- Impoundment full of coarse sediment

BRIDGE SECTION



EXISTING CROSS ROAD BRIDGE
DOWNSTREAM FACE HEC–RAS SECTION (RS 34+80)

SCALE: 1"=10'

MILONE & MACBROOM®

PROJECT TIMELINE

- 1848 – Dam Built
- 2006 – 2008 - Initial design by others based on traditional hydraulic design
  - Rigid bed design
  - Many structural elements
- 2009 - MMI began with peer review
  - Expanded Analysis
  - Final Design/Permitting
- Fall 2010 – Deconstruction of Briggsville Dam
- Spring 2011 – Final stage of site restoration
- Late Summer 2011 – Tropical Storm Irene

DEGRADATION ISSUES

- Will dam sediments erode?
- Will sediments become armored?
- Will erosion rate > deposition rate?
- Future base level?
- New equilibrium slope?
- Will future channel gradient undermine bridge?

FIELD WORK

- Multiple reach geomorphic inspection and classification
- Substrate identification

Project/Sample Information

Project	Briggsville Dam Removal - Supplemental Design
Stream	Hoosic River
Location	Clarksburg, MA
Sample ID	PC-D (U/S Driveway Bridge)
Sample Date	31-Aug-09
Sampled By	RKS
Sample Method	zigzag wolman pebble count with collapsable ruler (ft)

Particle Distribution (%)

silt/clay	0
sand	10
gravel	22
cobble	44
boulder	24
bedrock	0

Sample Site Descriptions by Observations

Channel type	riffle, possible aggradation upstream of bridge, less incised
D100 (mm)	
Colluvium	none
Debris	minimal
Other	turbid water from clay bank seep upstream

Particle Sizes (mm)

D16	13
D35	71
D50	**124**
D84	389
D95	616

(Bunte and Abt, 2001)

Particle Name	Size Limits (mm) lower	upper	Tally	Count	Percent Passing	Cumulative % Finer
silt/clay	0	**0.063**			0.0	0.0
very fine sand	0.063	**0.125**			0.0	0.0
fine sand	0.125	**0.250**			0.0	0.0
medium sand	0.250	**0.500**		11	10.2	10.2
coarse sand	0.500	**1**			0.0	10.2
very coarse sand	1	**2**			0.0	10.2
very fine gravel	2	**4**		1	0.9	11.1
fine gravel	4	**5.7**			0.0	11.1
fine gravel	5.7	**8**		4	3.7	14.8
medium gravel	8	**11.3**			0.0	14.8
medium gravel	11.3	**16**		4	3.7	18.5
coarse gravel	16	**22.6**		4	3.7	22.2
coarse gravel	22.6	**32**		8	7.4	29.6
very coarse gravel	32	**45**		1	0.9	30.6
very coarse gravel	45	**64**		2	1.9	32.4
small cobble	64	**90**		9	8.3	40.7
medium cobble	90	**128**		11	10.2	50.9
large cobble	128	**180**		13	12.0	63.0
very large cobble	180	**256**		14	13.0	75.9
small boulder	256	**362**		6	5.6	81.5
small boulder	362	**512**		13	12.0	93.5
medium boulder	512	**1024**		6	5.6	99.1
large boulder	1024	**2048**		1	0.9	100.0
very large boulder	2048	**4096**			0.0	100.0
bedrock	4096	**-**			0.0	100.0
			Total	108	100.0	-

(Wentworth, 1922)

F-T Particle Sizes (mm)

F-T n-value	0.5
D16	12.7
D5	1.2

(Fuller and Thompson, 1907)

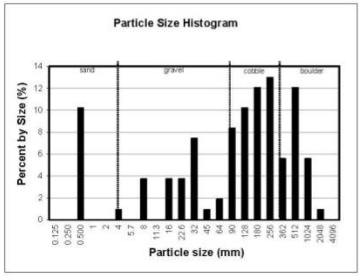
D (mm) of the largest mobile particles on bar

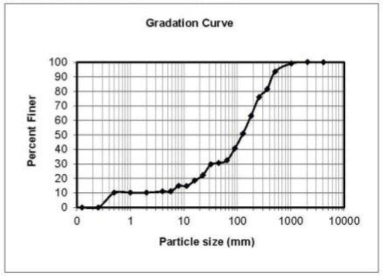
Mean	

Riffle Stability Index (%)

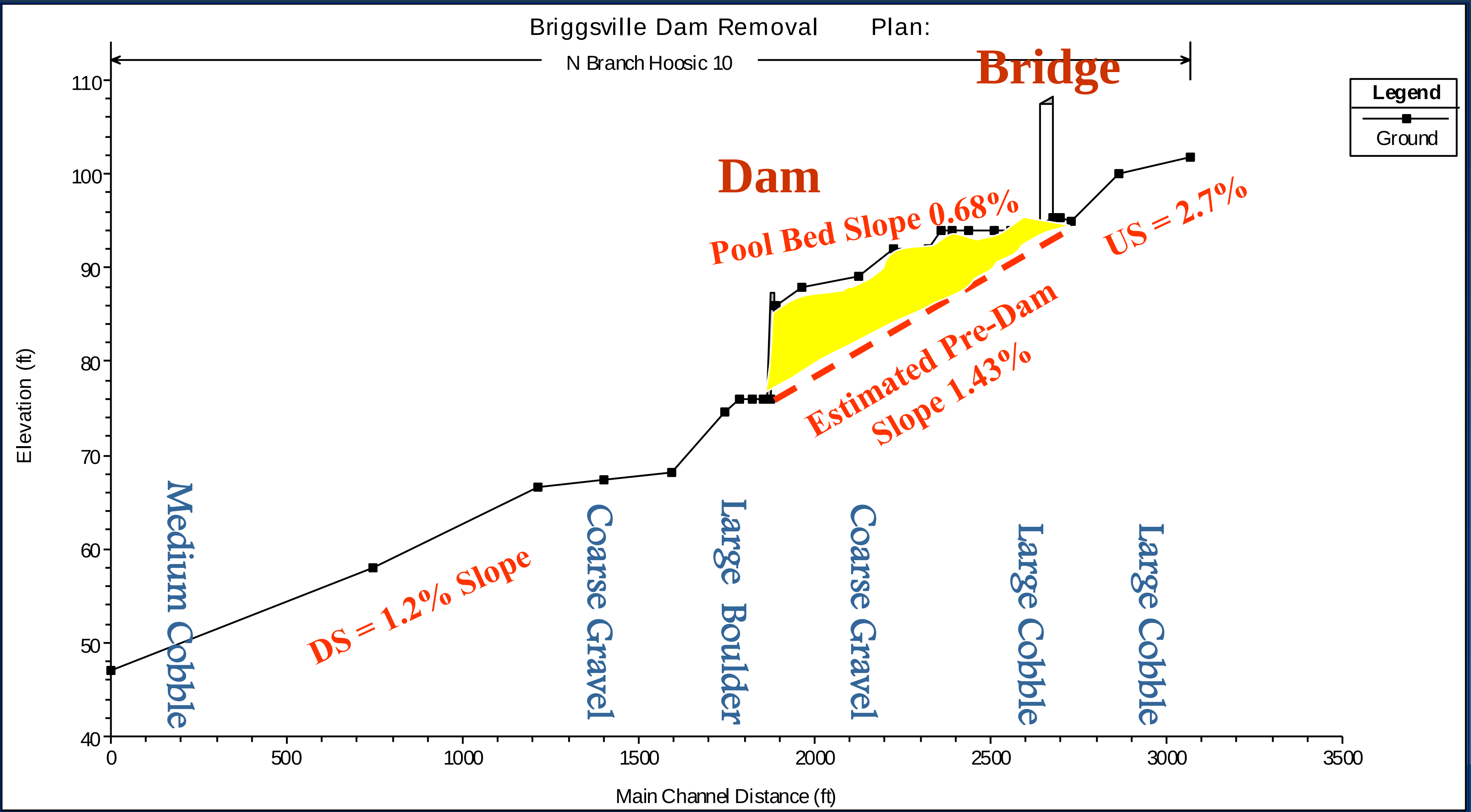
(Kappesser, 2002)

Notes





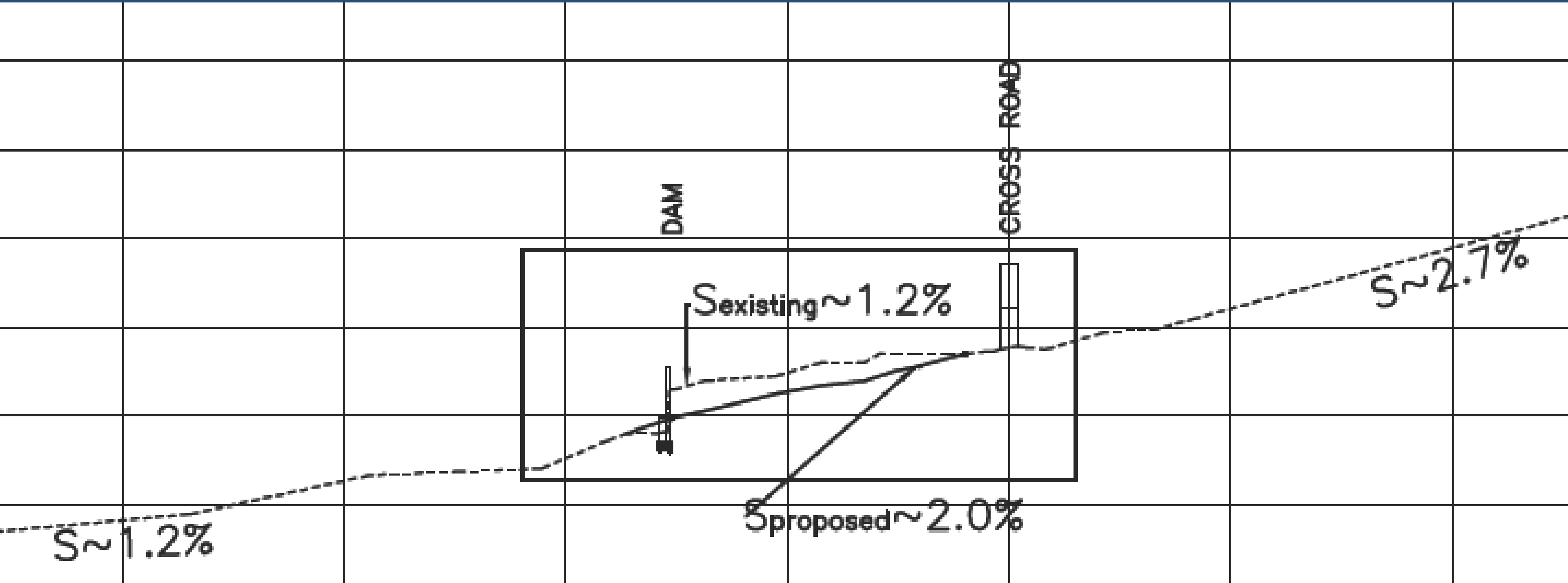
CHANNEL & SEDIMENT PROFILE



Milone & MacBroom®

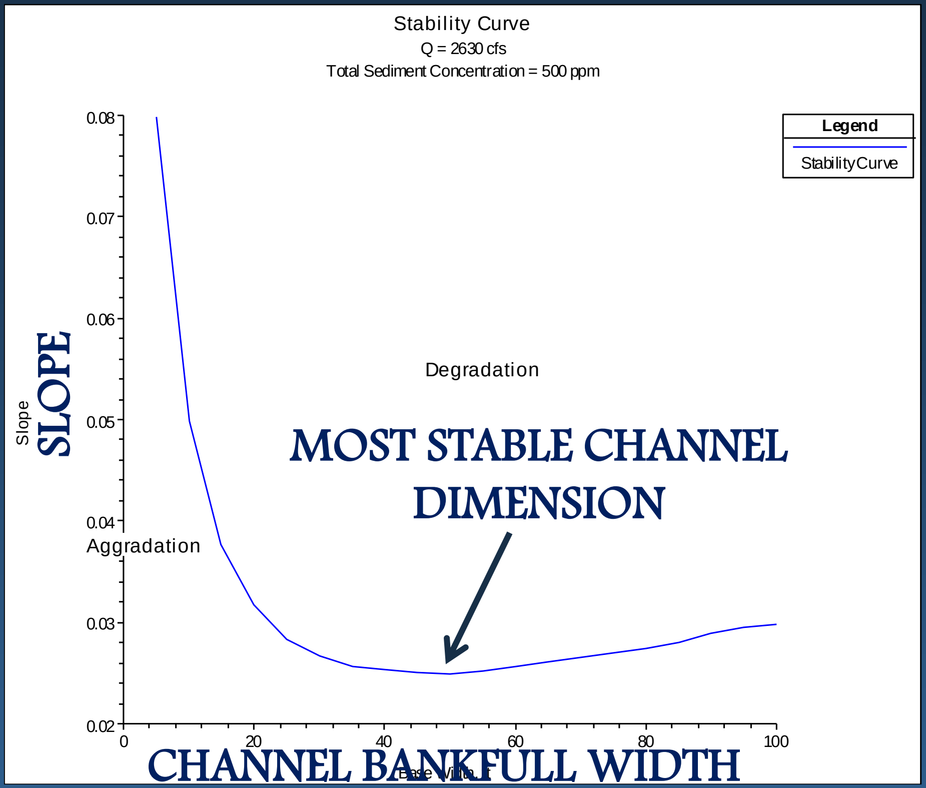
PROFILE & EQUILIBRIUM SLOPE

- Shields Resistance to Motion = 1.3 to 2.4%
- Sediment Transport Modeling = 2%
- Connection of Slope Transitions = 2%
- Proposed Slope = 2%



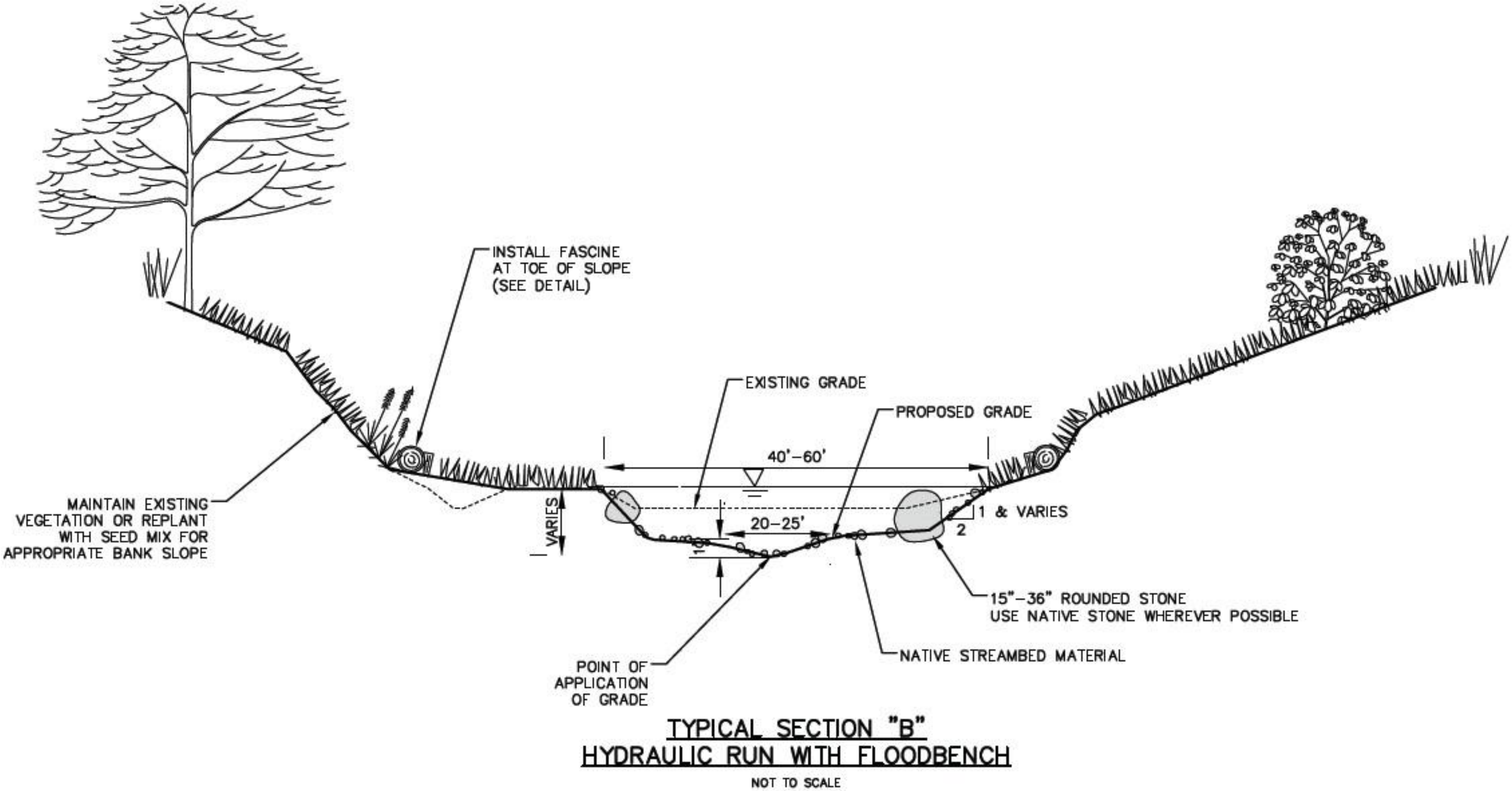
STABLE CHANNEL DIMENSIONS

- Estimated using HEC-RAS, Copeland Method
- Range of Sediment Concentrations (100-1000 ppm)
- Will need to reintroduce the low flow and bankfull channels and floodplain



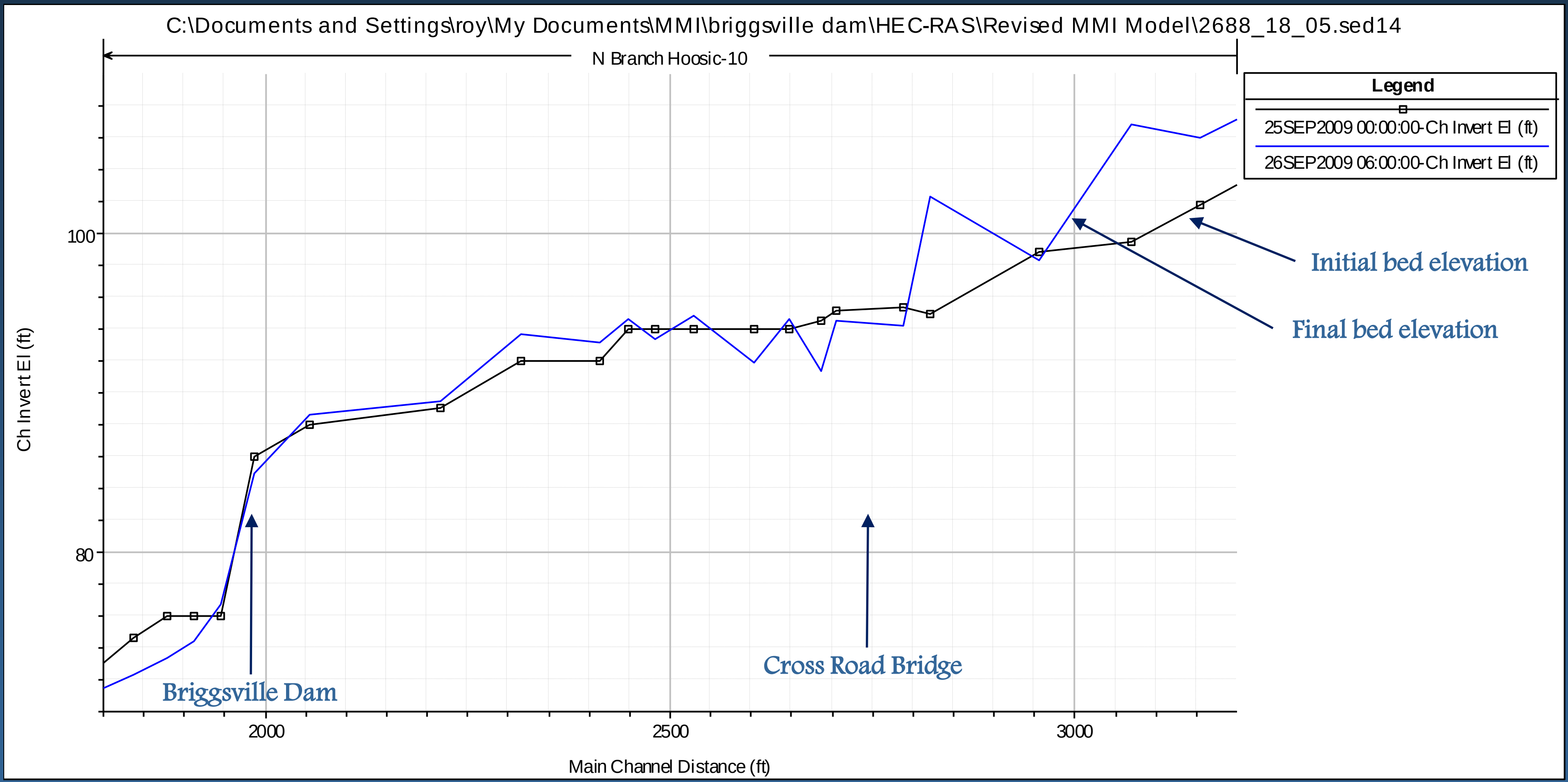
$C_{sediment}$ (ppm)	Width	Depth	EGL slope	Velocity	Shear
(ppm)	(ft)	(ft)	(%)	(ft/sec)	(lb/ft^2)
100	51.3	4.5	1.6	9.8	4.6
500	48.9	4.0	2.7	11.7	6.6
1000	46.5	3.8	3.5	12.9	8.3

TYPICAL CHANNEL SECTION



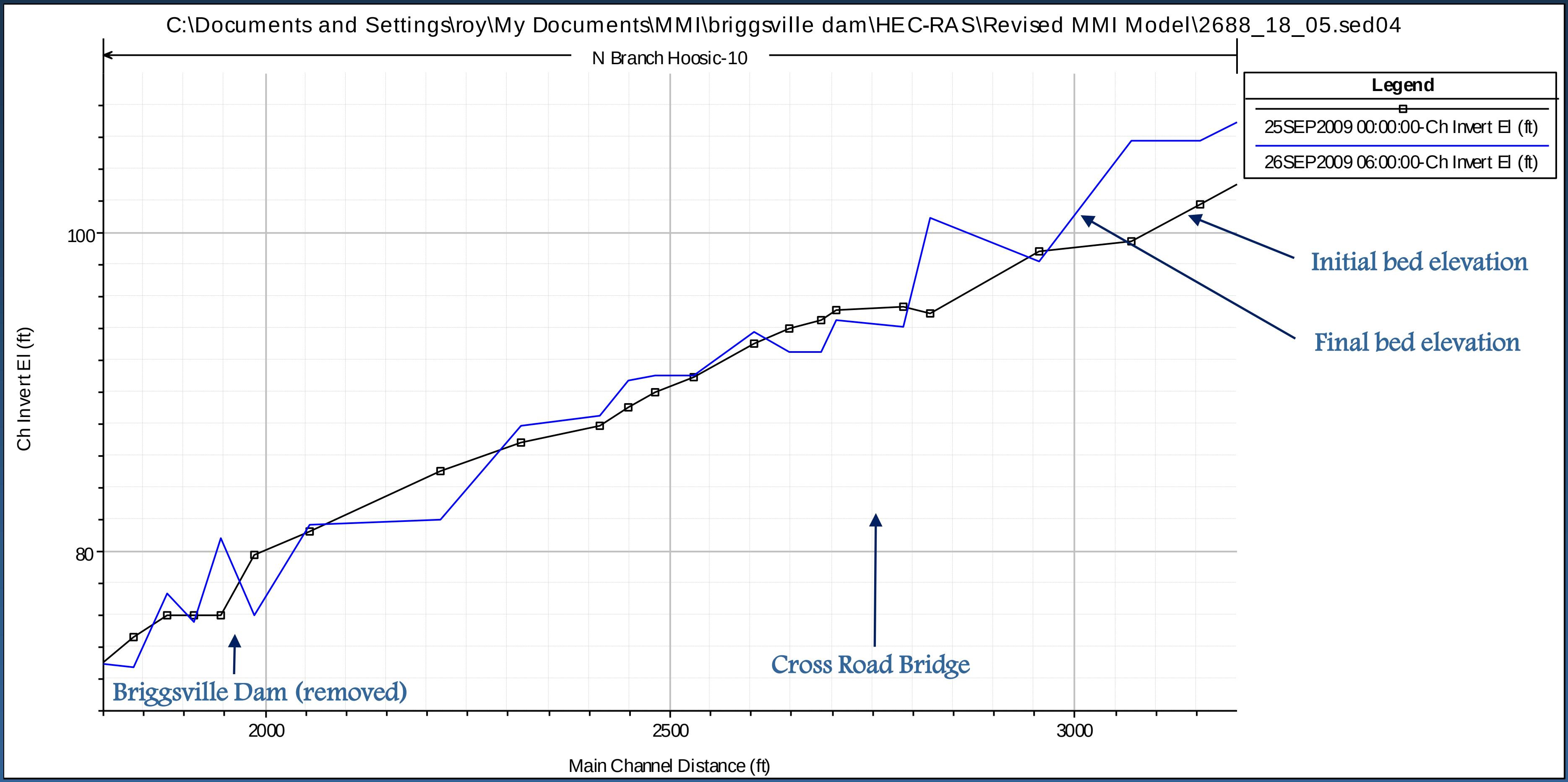
MILONE & MACBROOM®

SEDIMENT TRANSPORT – EXISTING 10-YEAR



MILONE & MACBROOM®

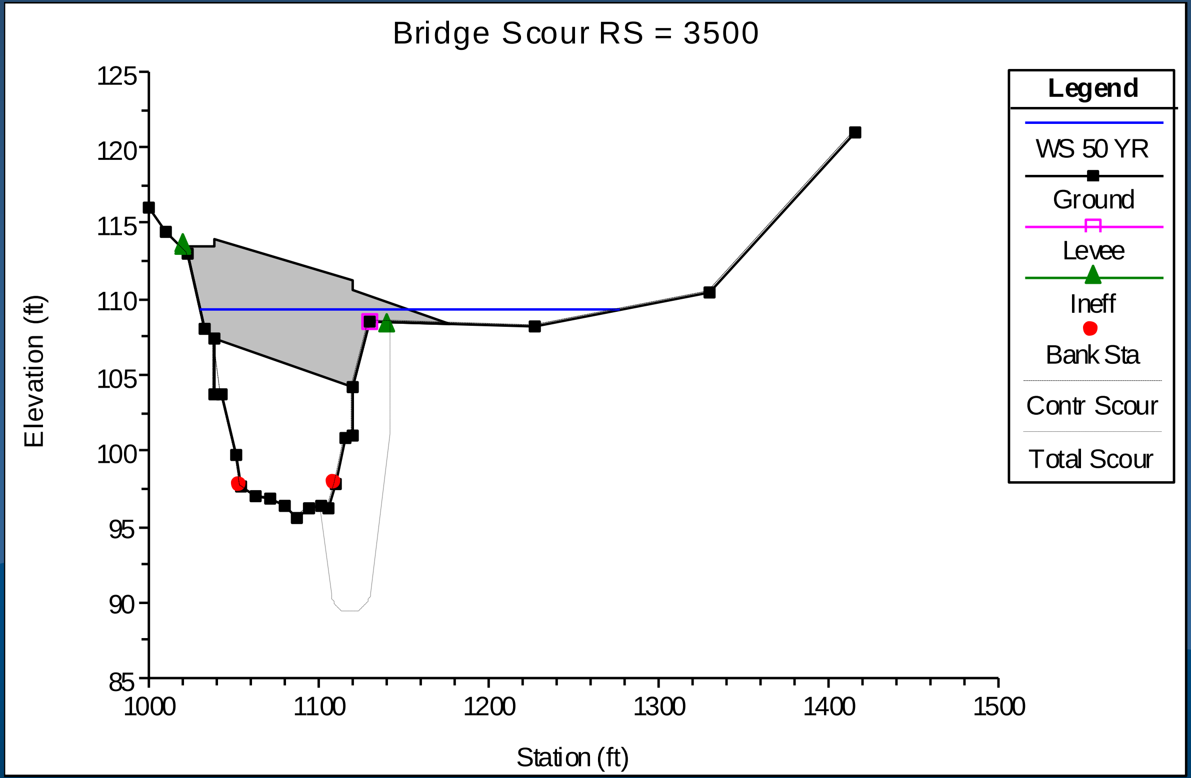
SEDIMENT TRANSPORT – PROPOSED 10-YEAR



MILONE & MACBROOM®

LOCAL BRIDGE SCOUR

- Scour Analysis Followed Hydraulic Engineering Circular No.18 (FHWA, 2001) using HEC-RAS
- Right Abutment Scour Calculated for both Existing and Proposed = No Change
- No Contraction Scour

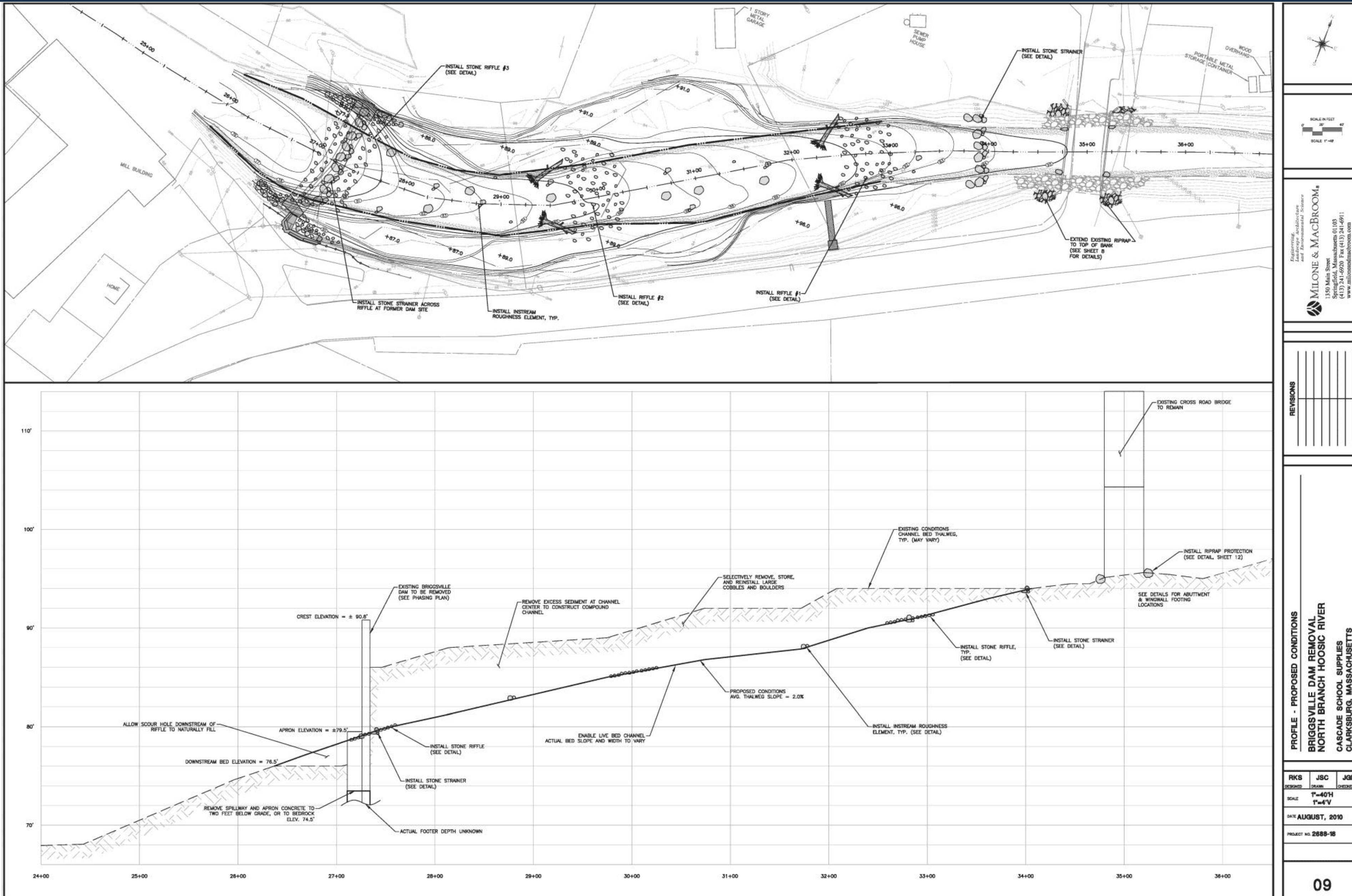


MILONE & MACBROOM®

DESIGN CONCLUSIONS

- Live bed design possible, without rock weirs
- Sediment source verified by modeling and history
- Minor degradation and aggradation anticipated in Post-dam Channel
- Pre-dam Slope = Equilibrium Slope = 2%
- Bridge Subject to Scour, Existing and Proposed

FINAL DESIGN



CONSTRUCTION

®

BRIDGE SCOUR COUNTERMEASURES

- Extend existing riprap to top of bank
- Add toe boulders to deflect and break up flow path
- Grout between existing riprap under bridge

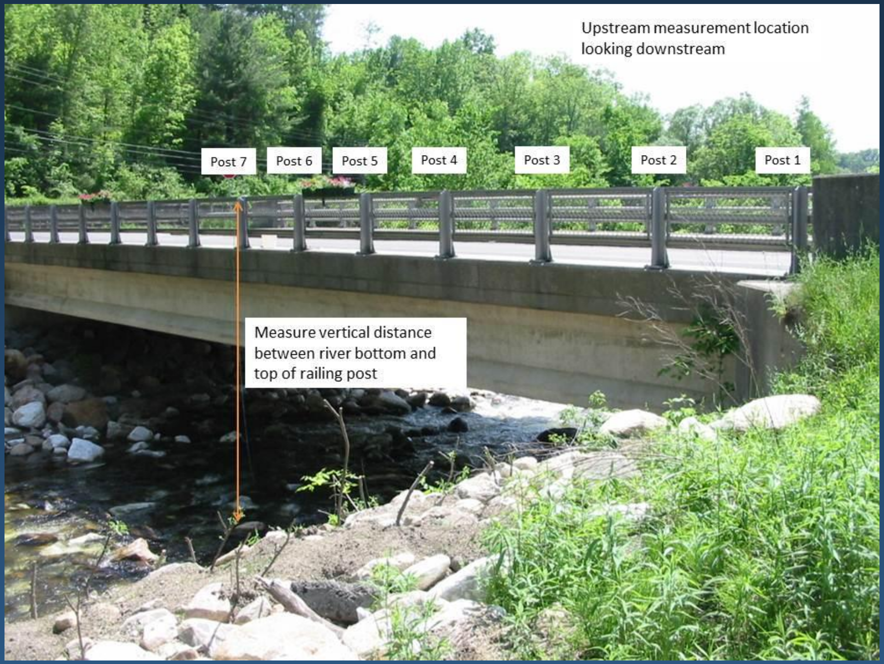
RESTORATION

MILONE & MACBROOM®

DEGRADATION MONITORING

- After spring floods:
  - upstream unchanged
  - downstream aggraded 0.5 feet

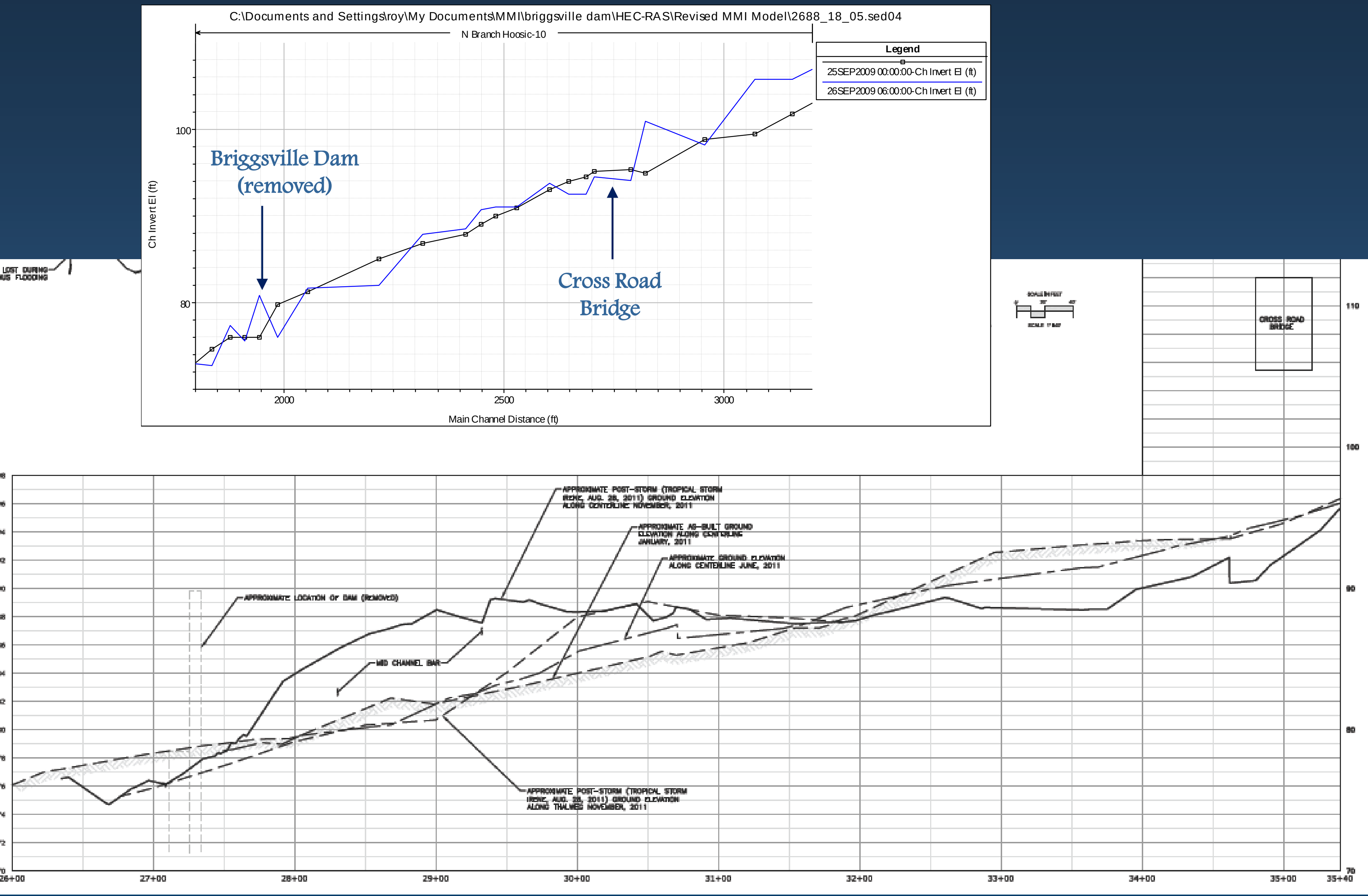
- After Tropical Storm Irene:
  - upstream degraded 1.5 feet
  - downstream degraded 3.5 feet



Date	Upstream	Downstream	Notes
November 1, 2010	19.7	20.6	No change during next three weekly measurements.
November 29, 2010	20.2	20.3	Midway through dam removal process
December 2, 2010	20.0	20.3	After large December 1 flood.
December 6, 2010	19.8	22.0	End of river construction
April 8, 2011	19.7	22.0	Beginning of vegetation planting
May 31, 2011	19.7	21.5	After Spring Flooding
November 2011	21.2	25	After Tropical Storm Irene

MILONE & MACBROOM®

RIVER PROFILE CHANGE



PROJECT CONCLUSIONS

- Sediment transport and expanding the spatial scale of the study was essential for a geomorphically compatiable design and helped reduce construction costs
- Channel bed degraded near bridge as predicted by sediment transport as well as aggradation over the project reach
- Dam successfully removed
- Project goals for improved fish passage and local habitat and reduced flood risk were met

QUESTIONS?

MILONE & MACBROOM®